SCHEME OF EXAMINATION & SYLLABI

M. Phil. PHYSICS (Choice Based Credit System)
(TWO SEMESTERS COURSE)

w.e.f. SESSION 2016-17

DEPARTMENT OF PHYSICS

CHAUDHARY DEVI LAL UNIVERSITY, SIRSA

Department of Physics
Chaudhary Devi Lal University, Sirsa

M. Phil. Physics (Choice Based Credit System)
(Two Semesters Programme)
Scheme of Examination and Syllabi w.e.f. Session 2016-17

Semester-I

Type of course	Course Code	Title of Course	Teaching Hours per week	Credits	Internal Assessment/ Evaluation	End term Examination	Total	Duration of Exam.(Hrs.) Theory/ Practical
Core	PHY-501	Research Methodology	4	4	30	70	100	3
Core	PHY-502	Advances in Physics	4	4	30	70	100	3
Any one of the following discipline electives (PHY-503A, PHY-503B, and PHY-503C)								
Discipline elective	PHY-503A	Laser and Spectroscopy	4	4	30	70	100	3
	PHY-503B	Nano Science and Technology						
	PHY-503C	Non-linear Dynamics						
Open elective	*	*	2	2	20	30	50	3
Total				**14**			**350**	

Semester-II

Type of course	Course Code	Title of Course	Teaching Hours per week	Credits	Internal Assessment/ Evaluation	End term Examination	Total	Duration of Exam. (Hrs.) Theory/ Practical
Core	PHY-601	Seminar		2			50	
Discipline elective	PHY-602	Dissertation		12				
Total				**14**				

***Open Elective Course: For the students of M.Phil. Physics**

The student will earn **two** credits by choosing one of the open elective courses offered by the different departments in the university other than the Department of Physics.

Open Elective Course: For the students of M.Phil. of other departments of the university

The Department of Physics offers the following open elective course for the students of first/second semesters of M.Phil. of other departments of the university.

Type of course	Course Code	Title of Course	Teaching Hours per week	Credits	Internal Assessment/ Evaluation	End term Examination	Total	Duration of Exam. (Hrs.)
Open elective	OEC-PHY-504	Basics of Lasers	2	2	20	30	50	3

General instructions:

1. Each student will deliver seminars on the topics to be allotted by the departmental seminar committee. The marks will be awarded by the seminar committee on the basis of his/her attendance (5 marks), seminar reports (20 marks), ppt presentations (20 marks) and discussions (5 marks).
2. The discipline elective courses will be allotted to the students on the basis of their preference, merit and availability of seats under the concerned supervisor.
3. The M.Phil. Ordinance (Choice Based Credit System) of the university shall be followed by the department.

PHY-501: RESEARCH METHODOLOGY

Credits: 4
Periods per week: 4 Hrs.

Max. Marks: 70
Duration of Exam.: 3 Hrs.

Note: There are **nine** questions in all. Question No. 1 is compulsory consisting of 5 short questions of 2 marks each. Students have to attempt **five** questions in all including compulsory question, selecting one question from each unit.

Unit-I

Introduction: Concept of research; characteristics features of research, Types of research, objectives of research, Review of Literature. Scope of research, validity and reliability of research, Process of research: steps involved in research process, Selecting a research topic, Planning and designing research, Criteria of good research, Rules and principles of scientific methods, Hypothesis, Data collection, Analysis and interpretation of data, Experimental techniques.

Unit II:

Errors & Curve Fitting: Errors- Round off error, Truncation error, Machine error, Random error, Propagation of errors. Loss of Significance: Significant digits, Computer caused loss of significance, Avoiding loss of significance in subtraction, Least square curve fitting: The principle of least square fitting, Linear regression, Polynomial regression, Fitting exponential and trigonometric functions.

Unit III

Hypothesis: Meaning of hypothesis, Importance of hypothesis, Types of hypothesis, Source of hypothesis, Characteristics of hypothesis, Use of hypothesis in research, Different form of hypothesis, Difficulties in the formation of hypothesis, Testing of hypothesis, Test of significance, Steps in testing, Student's t- distribution, F-test, Chi-Square (χ^2) test.

Unit-IV

Preparation of Dissertation: writing a scientific paper, Journal impact factor, citation index, seminar, conference and workshops, Types and layout of research, Precautions in preparing the research dissertation, Bibliography and annexure, Discussion of results, Draw conclusions, Giving suggestions and recommendations to the concerned persons.

Text and Reference Books:

1. K. Prathapan : Research Methodology for Scientific Research (IK International)
2. C.R. Kothari : Research Methods, Methods & Techniques (Second Revised Edition)
3. P.B. Patil and U.P. Verma : Numerical Computational Methods (Narosa Pub. House)
4. S.S. Sastry : Introductory Methods of Numerical Analysis (PHI)
5. Santosh Gupta : Research Methodology and Statistical Techniques (Deep Publication)

PHY-502: ADVANCES IN PHYSICS

Credits: 4
Periods per week: 4 Hrs.

Max. Marks: 70
Duration of Exam.: 3 Hrs.

Note: There are **nine** questions in all. Question No. 1 is compulsory consisting of 5 short questions of 2 marks each. Students have to attempt **five** questions in all including compulsory question, selecting one question from each unit.

Unit-I

Thin film deposition processes: Resistive heating, R.F. heating, Electron bombardment heating, Laser ablation, RF, DC & Ion beam sputtering, Electrodeposition, Chemical vapor deposition, MOCVD, PECVD, Choice of thin film substrates.
Measurement of thickness of thin films: Basic principle involved in optical, electrical, mechanical and radiation based thickness measurement techniques.

Unit-II

Laser mode's characteristics: spatial and frequency dependence, Mode competition, Effect of modes on gain medium profile: spatial and spectral hole burning, Properties of Gaussian and real laser beams, Pulse shortening techniques: Self phase modulation and pulse compression, Intensity dependent refractive index, Saturable absorption.

Unit-III

Photochoromic and electrochromic materials, Optical properties of semiconductors, Second – order optical nonlinearity, Third order optical nonlinearity, Perovskites, Poled ploymers, Photosensitive and photothermal materials, brief idea of multiferroic materials & Photo refractive materials and their important applications.

Unit IV

Field Quantization: Introduction, Classical and Quantum field equations: Coordinates of the field, Time derivatives, Classical Lagrangian equation, Classical Hamiltonian equations; Quantum equation of the field, Field with more than one component, Complex field, Quantization of the non relativistic Schrodinger equation (Second quantization): Classical Lagrangian and Hamiltonian equations, Quantum field equations.

Text and Reference Books:

1. K. Thyagarajan and A.K. Ghatak : Laser: Theory and Applications
2. C.C. Davis : Laser and Electro-optics
3. Willian T. Silfvast : Laser Fundamentals
4. Joseph H.Simmons and Kelly S. Potter : Optical Materials
5. L.I. Maissel and R. Glang : Hand book of thin film technology
6. K.L. Chopra : Thim film phenomena
7. Milton Ohring : Materials Science of Thin Films.
8. L.C. Feldman & J.W. Mayer : Fundamentals of Surface & Thin Film Analysis.
9. L.I. Schiff : Quantum Mechanics (3rd Edition)
10. J.J. Sakurai : Advanced Quantum Mechanics

PHY-503A: LASER AND SPECTROSCOPY

Credits: 4
Periods per week: 4 Hrs.

Max. Marks: 70
Duration of Exam.: 3 Hrs.

Note: There are **nine** questions in all. Question No. 1 is compulsory consisting of 5 short questions of 2 marks each. Students have to attempt **five** questions in all including compulsory question, selecting one question from each unit.

Unit – I

Properties of laser radiation and laser safety; Laser systems: Er-doped silica fiber laser, Ti: Sapphire laser, Review of Semiconductor lasers; Double heterostructure and quantum-well lasers, Distributed feedback laser, Diode laser array, Applications of lasers in data storage, Conventional holography.

Unit – II

Maxwell's equation in non-linear medium, Steady state nonlinear optical effects, Slowly varying envelope approximation, Classical, Semi-classical and Quantum approaches (Elementary Idea only), Nonlinear polarization & susceptibilities, Three wave mixing phenomenon, sum & difference frequency generation, Phase matching conditions, Parametric amplification and oscillation, Second harmonic generation, and its conversion efficiency.

Unit – III

Stimulated Brillouin scattering, Optical phase conjugation, Real time holography, Two photon absorption, Z-scan technique, Self-focusing and self-defocusing phenomena and its applications, Group velocity dispersion, Interaction between ideal two level atoms (semi classical approach), Induced dipole moment.

Unit – IV

Principle, construction and applications of techniques: Laser Raman spectroscopy, High sensitivity methods of absorption spectroscopy; frequency modulation and intracavity absorption (using single and multimode operation), fluorescence excitation spectroscopy, Fabry-Perot spectroscopy, Laser induced fluorescence spectroscopy.

Text and Reference Books:

1. J.T. Verdeyen : Laser Electronics
2. C. C. Davis : Lasers and Electro-optics
3. W. T. Silfwast : Lasers Fundamentals
4. O. Svelto : Principles of Lasers
5. D.S. Ahlawat : Basics Concepts of Laser Physics
6. A. Ghatak & K. Tayagrajan : Laser (Theory & Applications)
7. R. W. Boyd : Nonlinear Optics
8. Y. R. Sen : Principle of Nonlinear Optics
9. R. Syms and J. Cozens : Optical Guided Waves and Devices

PHY-503B: NANO SCIENCE AND TECHNOLOGY

Credits: 4
Periods per week: 4 Hrs.

Max. Marks: 70
Duration of Exam.: 3 Hrs.

Note: There are **nine** questions in all. Question No. 1 is compulsory consisting of 5 short questions of 2 marks each. Students have to attempt **five** questions in all including compulsory question, selecting one question from each unit.

Unit-I

Introduction to Nanoscience, 1D, 2D and 3D confinements, Density of states, Exciton, Surface plasmon, Energy bands; Size dependence of properties; Classification of nanomaterials/nanostructures; Semiconductor quantum well, wire and dot; Structural, Optical Chemical, Mechanical, Magnetic properties of nanoparticles; Emergence of nanotechnology and its applications.

Unit-II

Preparation/Synthesis of Nanostructured materials: Top-down and Bottom-up approaches, Idea of some important physical and chemical techniques: Ball milling, Ion beam sputtering, Pulsed laser deposition, Chemical vapor deposition, Sol-gel, Co-precipitation, Electro-deposition.

Unit-III

Principle, instrumentation, methodology and applications of following techniques:
Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Atomic force microscopy (AFM), Energy dispersive X-ray fluorescence (EDX/EDS), X-ray photoelectron spectroscopy (XPS/ESCA).

Unit-IV

Principle, instrumentation, methodology and applications of following techniques:
X-ray diffraction (XRD), UV-Visible spectroscopy, Fourier transform infrared spectroscopy (FTIR), Raman spectroscopy, Photoluminescence (PL), Vibrating Sample Magnetometry (VSM).

Text and Reference Books:

1. M. Wilson et al : Nanotechnology
2. Guozhong Cao : Nanostructures & Nanomaterials
3. C.P. Poole & F.J. Qwens : Introduction to Nanotechnology
4. N. Peyghambarian et.al : Introduction to Semiconductor Optics
5. K.P. Jain : Physics of Semiconductor Nano Structures
6. John H. Davies : Physics of Low Dimensional Semiconductors
7. J. H. Fendler (Ed.) : Nanoparticles and Nanostructured Films
8. Paul Harrison : Quantum Wells, Wires and Dots
9. A.S. Edelstein & R.C. Cammarata :Nanomaterials: Synthesis, Properties & Applications
10. C.R. Brunde & A.D Baker : Electron spectroscopy: Theory, Technique & Applications
11. Lakowic : Principle of Fluorescence Spectroscopy.

PHY-503C NON-LINEAR DYNAMICS

Credits: 4
Periods per week: 4 Hrs.

Max. Marks: 70
Duration of Exam.: 3 Hrs.

Note: There are **nine** questions in all. Question No. 1 is compulsory consisting of 5 short questions of 2 marks each. Students have to attempt **five** questions in all including compulsory question, selecting one question from each unit.

Unit-I

Linear and Nonlinear Systems : Introduction, Dynamical systems, Mathematical Implications of Nonlinearity, Effects of Nonlinearity, History of Dynamics, Importance of being nonlinear, Linear oscillators and Predictability - Free Oscillations, Forced Oscillations and Damped oscillations, Damped and Driven Nonlinear Oscillators- Free Oscillations, Forced Oscillations and Damped oscillations.

Unit-II

Integrability : Introduction, Integrable and Nonintegrable systems, Different types of Invariants, some formal remarks about the dynamical invariants, Forms of Second invariants, Construction of the Second invariants, Superintegrable systems, Classical and Quantum Integrable Systems, Complete integrability-Complex analytical integrability, Symmetries and Integrability, Integrable Discrete Systems.

Unit-III

Chaos and Fractals: Introduction, A Chaoitic waterwheel, Simple Properties of the Lorentz Equation, Chaos on a Strange Attractor, Lorentz Map, One dimensional Maps, Logistic Map: Numerics, Liapunov exponent, Probabilistic Construction of Fractals, Fractal and Deterministic Systems, Fractal Basin Boundaries, Fractal Dimensions, Chaoitic attractors, Lorentz attractor.

Unit-IV

KdV equation and Solitons : The Scott Russel Phenomena and KdV equation, The Birth of Solitons, Bilinerization method for Soliton solutions of KdV equation, Explicit Soliton solutions(for N=1,2), The Nonlinear Schrodinger Equation in Optical Fiber, Solitary wave solutions and Basic Solutions- Pulse soliton, Envelope solitons, Spin solitons, The Sine-Gordan equation-Kink, Antikink and Breathers

Text and Reference Books:

1. M. Lakshmanan and S. Rajasekar : Nonlinear Dynamics
2. R.S. Kaushal : Classical and Quantum Mechanics of Noncentral Potentials
3. Steven H. Strogatz : Nonlinear Dynamics and Chaos
4. Kaithleen T. Alligood, Tim. D Sauer and James A. Yorke : Chaos – An Introduction to Dynamical Systems

OEC-PHY-504: Basics of Lasers

Credits: 2
Periods per week: 2 Hrs.

Max. Marks: 30
Duration of Exam.: 3 Hrs.

Note: There are **nine** questions in all. Question No. 1 is compulsory consisting of 5 short questions of 2 marks each. Students have to attempt **five** questions in all including compulsory question, selecting one question from each unit.

Unit-I

Einstein coefficients and their relations, Population inversion, Laser pumping: electrical, optical and chemical, Transverse and longitudinal pumping geometries, Metastable states, Radiative and non-radiative decay of excited states, Basic properties of laser materials.

Unit-II

Introductory idea of laser resonators, Longitudinal modes of laser, Difference between LASER and MASER resonators, Types of laser resonators, Stable and unstable resonators, Stability diagram, Introductory idea of transverse modes, Energy stored by laser resonator.

Unit-III

Properties of laser light: directionality, intensity, monochromaticity, coherence, brightness, ultra short pulses, Applications of laser: holography, optical communication, LIDAR, medicine, medical surgery, precision length measurement, industrial use by material processing, laser welding, hole drilling, laser cutting.

Unit-IV

Line shape function, Introductory idea of line broadening mechanism: Homogeneous and inhomogeneous, Natural and collisional broadening, Doppler broadening, Laser amplification in a homogeneous broadened system and gain saturation.

Text and Reference Books:

1. K. Thyagarajan and A.K. Ghatak : Laser: Theory and Applications
2. C.C. Davis : Laser and Electro-optics
3. Willian T. Silfvast : Laser Fundamentals
4. D. S. Ahlawat : Basic Concepts of Laser Physics
5. B.B. Laud : Lasers and Non Linear Optics
6. P. Sarah : Lasers and Optical Fiber Communications